Study Method

INFR11158/11230 Usable Security and Privacy

Dr. Jingjie Li

30/01/2024

THE UNIVERSITY *of* EDINBURGH

Overview

- Reminder
- Cookie
- Study method
- Take-home

Blog submission

- Newly enrolled students please email TA (t.saka@sms.ed.ac.uk) and cc me for the first blog make up

Tutorials

- Tutorial 1: **Plan** a think-aloud study
- Tutorial 2: **Run** your planned think-aloud study and participant in someone else's
- Tutorial 3: **Plan and run** survey study
- Tutorial 4: **Analyze** the survey results

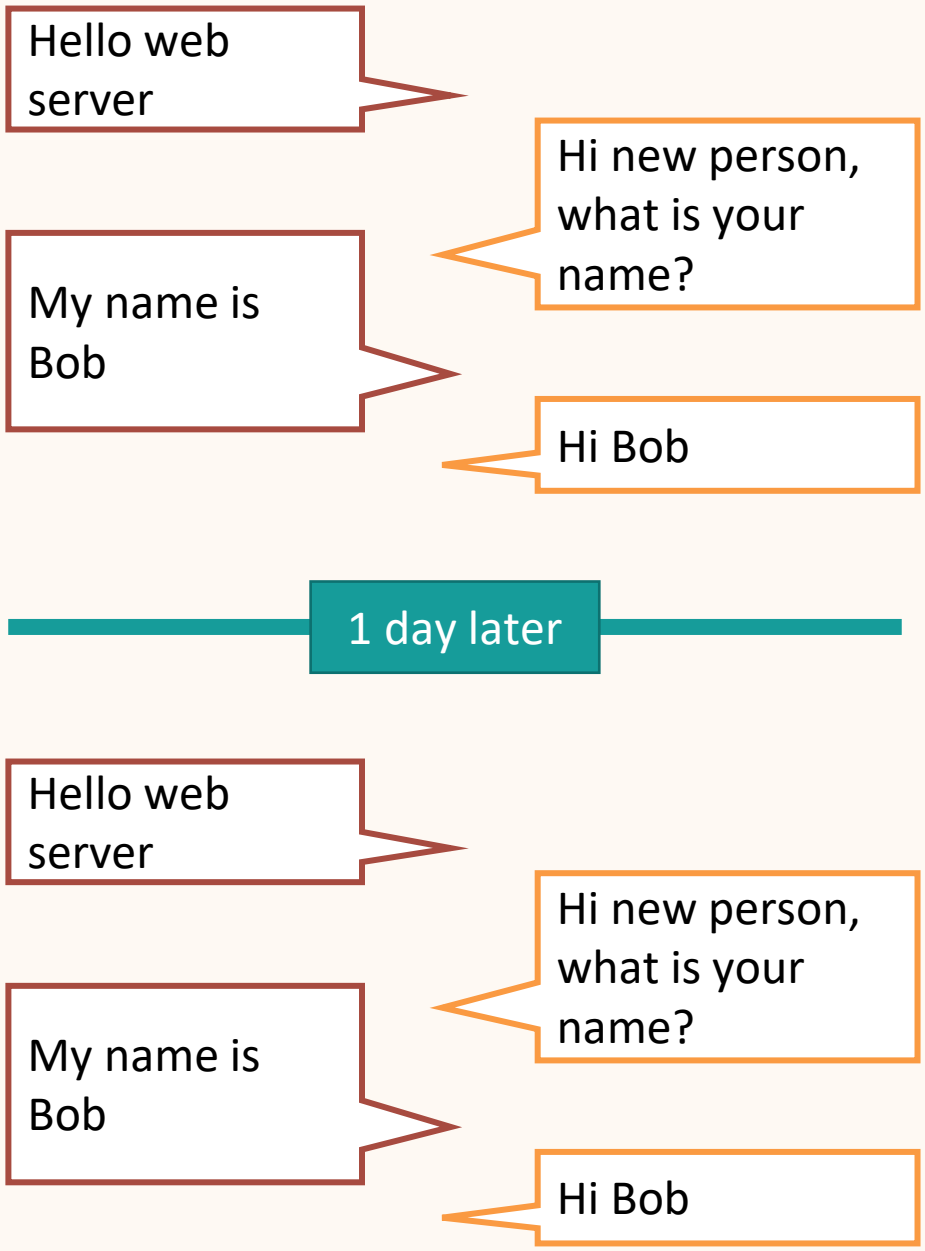
What is a cookie?

What does “opt-out” mean?

Designing the web cookie

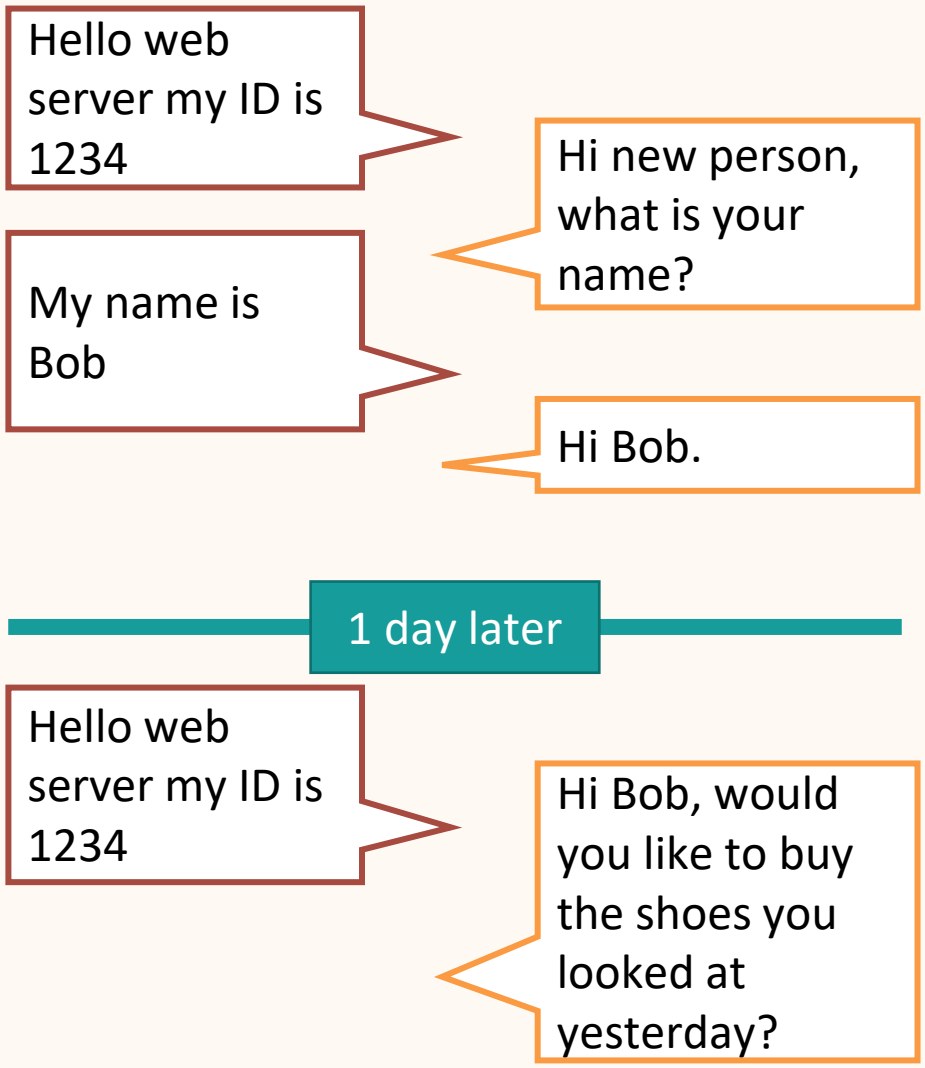
Heavily based on Lou Montulli’s “The reasoning behind Web Cookies”

The year is 1994 and there is a problem... the internet has no ability to remember a person between page reloads.

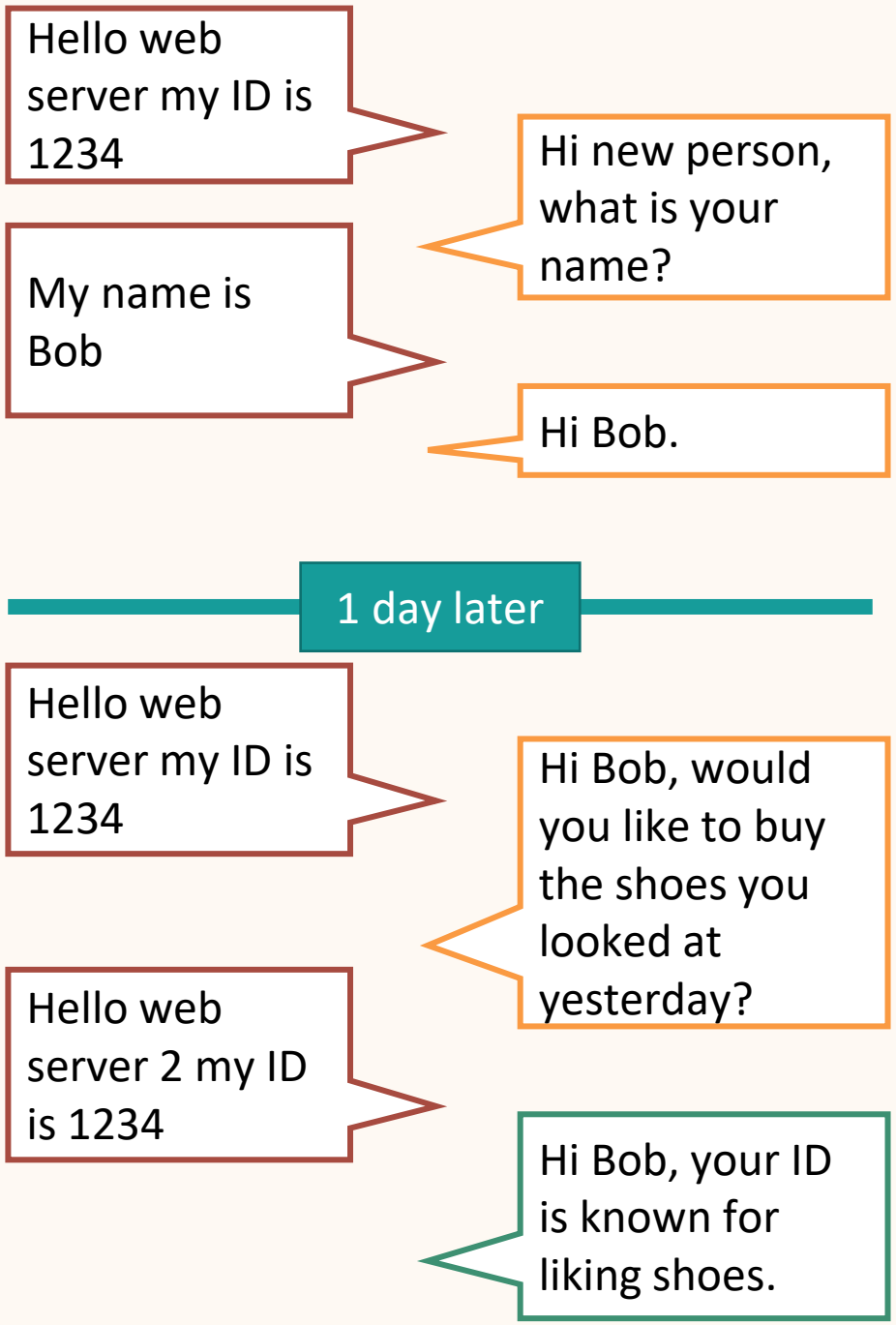


There is an obvious easy solution...

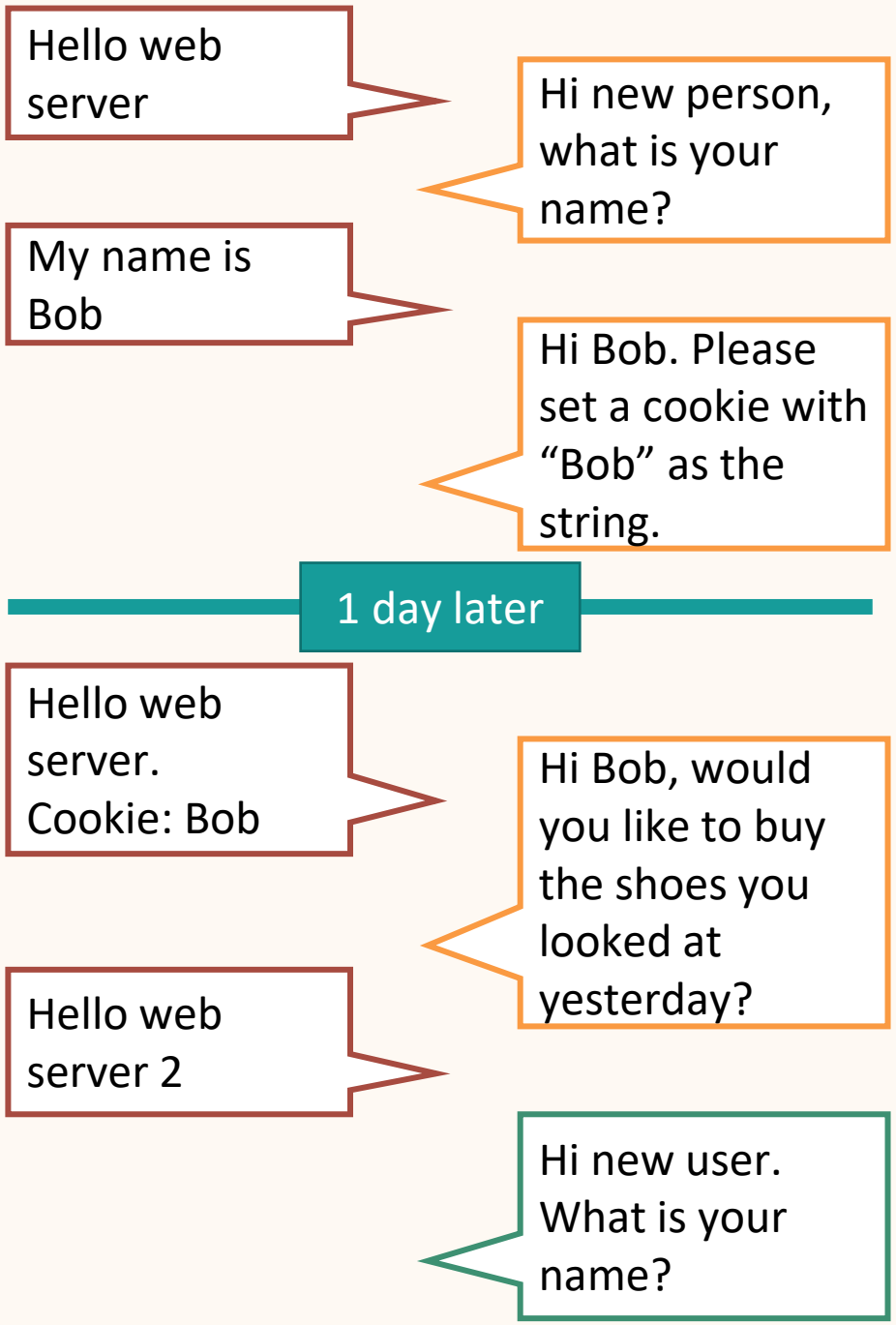
Give each browser a unique identifier that gets sent with every page request.



The problem with the obvious solution is privacy. Tracking would be possible with no visibility or control.



Instead Netscape implemented cookies. Small text strings the server could ask the browser to remember and give back to it later.



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His surreal one-man messaging war caps a 10-month journey to the center of Trump's impeachment battle

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Fact-check in real time: Tapper calls out Republican's claims

Ukraine: Sense of alarm that country will be victim of fallout

Pelosi: What Trump told me hours before impeachment inquiry

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Hong Kong protesters hit with blue water cannon after demonstrations turn violent

Addicted to porn at age 12. This is what he wants parents to know

Around the world

Politician's seized luxury supercars auctioned off

US sprinter crowned fastest man on earth

Secret-video scandal brought him down. Now controversial leader is set to return

Featured

Ferrari implosion gifts Hamilton surprise win

China preparing to show off some incredible weaponry

▼ Response cookies

▼ countryCode:

domain: .cnn.com

path: /

value: GB

▼ geoData:

domain: .cnn.com

path: /

value: berwick-upon-tweed|NBL|td15 1ph|GB|EU|100|broadband

▼ tryThing00:

domain: .cnn.com

expires: 2019-07-01T00:00:00.000Z

path: /

value: 0476

▼ Request cookies

__gads: ID=eca290ce4d2041cd:T=1550155631:S=ALNI_MbVJ-s8-hThPxcDDEVC-y0zl6uXAg

__qca: P0-1596947158-1550155632110

_cb: Dhc35fR8rJzdliKh

_cb_ls: 1

_chartbeat2: .1550155641619.1551437811203.1000000000000001.L-wxqD_EyStJpiWfCFzknRDzs-BQ.1

ajs_anonymous_id: "65b0b48c-adf2-4b2c-8222-c00a3afcb635"

ajs_group_id: null

ajs_user_id: null

AMCV_7FF852E2556756057F000101@AdobeOrg: -1303530583|MCAID|2E32BFB58507EBAA-6000010D8000C7E9|MCIDTS|18169|MCMID|92056194144261380875921726535507589307|MCOPTOUT-1569799377s|NONE|vVersion|3.3.0

AMCVS_7FF852E2556756057F000101@AdobeOrg: 1

countryCode: GB

FastAB: 0=9601,1=8428,2=6647,3=9874,4=7635,5=8957,6=3720,7=9919,8=5094,9=8302

geoData: berwick-upon-tweed|NBL|td15 1ph|GB|EU|100|broadband

gig_hasGmid: ver2

Who is tracking you?

3rd party cookie reasoning

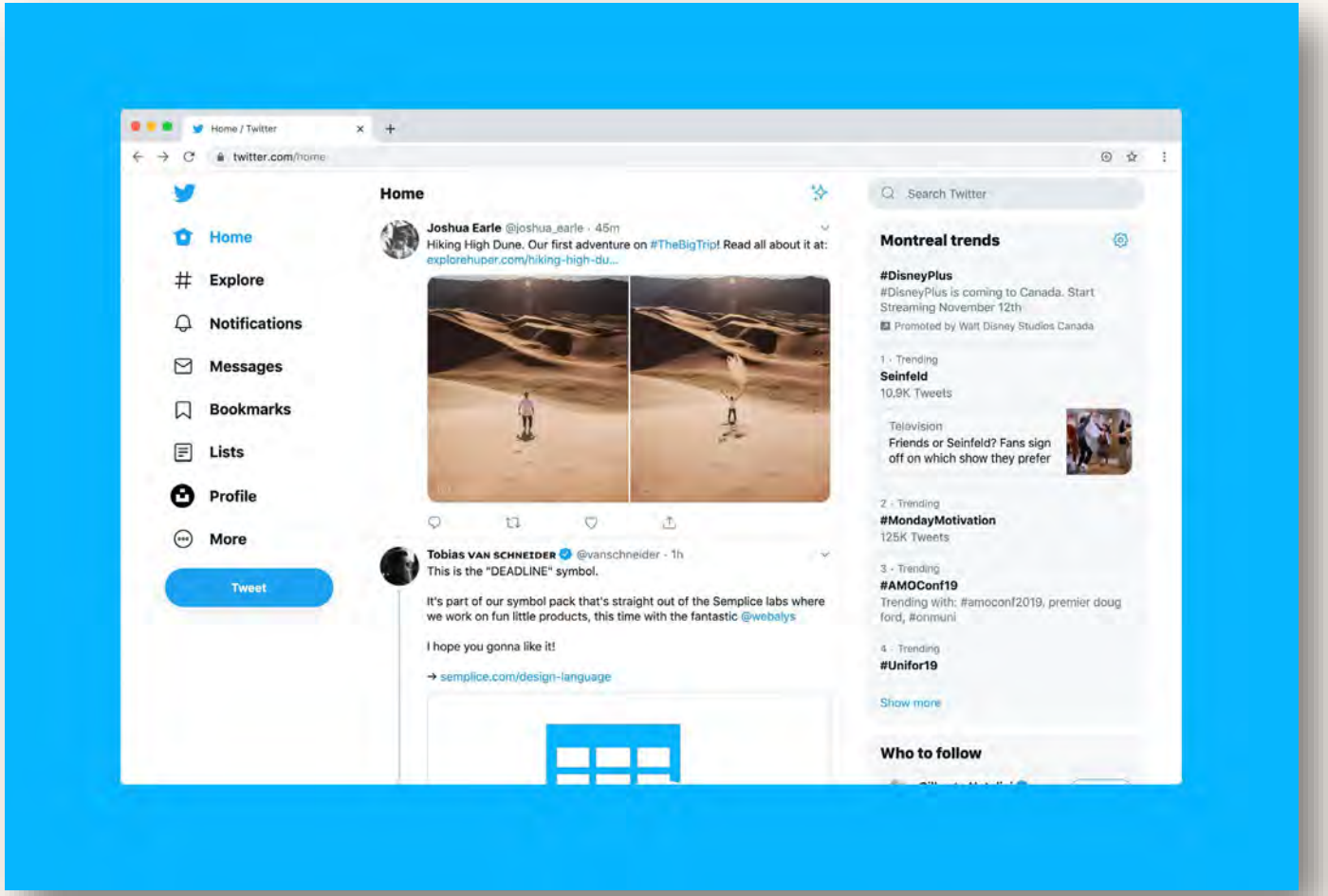
“Any company that had the ability to track users across a large section of the web would need to be a large publicly visible company.

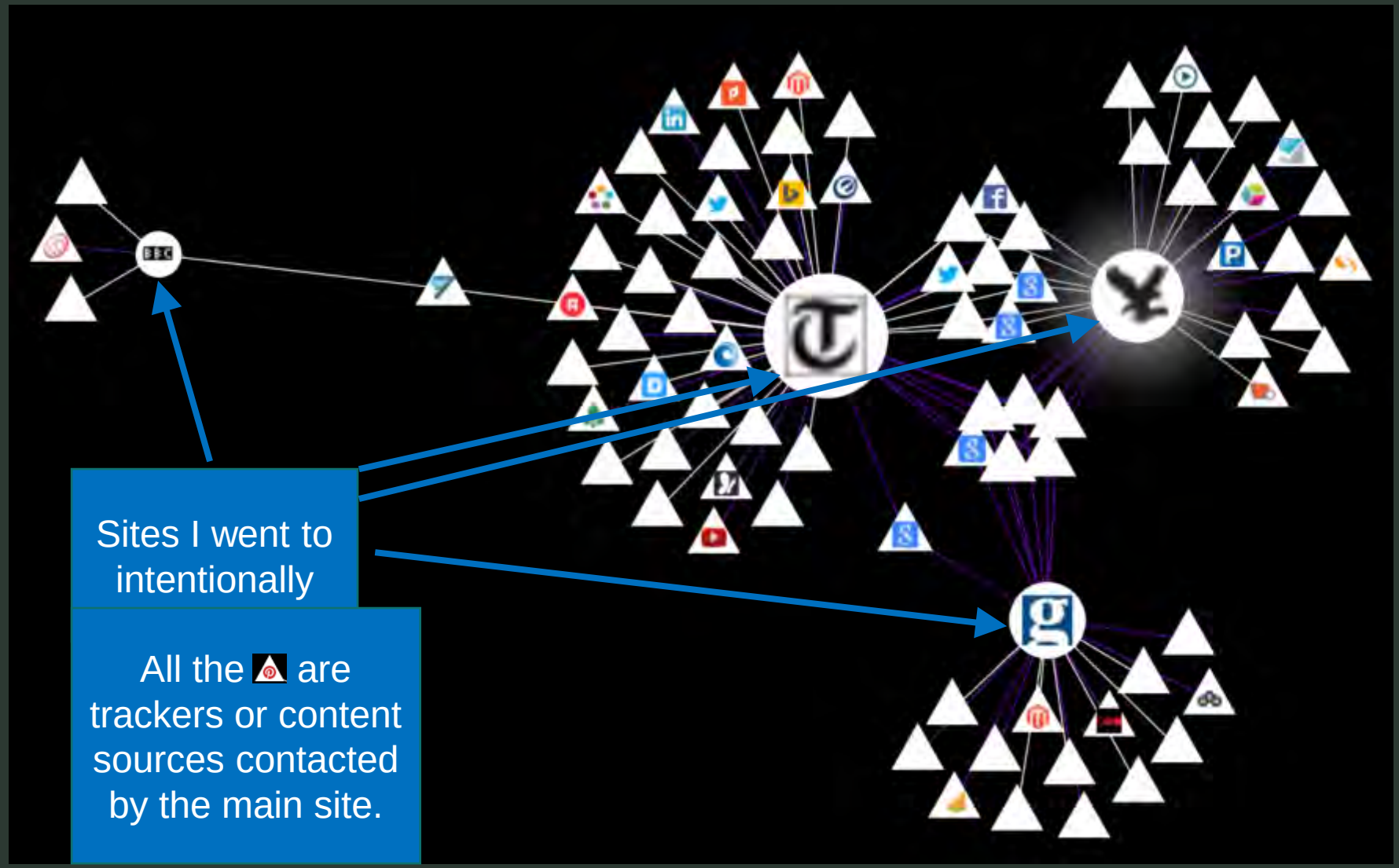
Cookies could be seen by users so a tracking company can't hide from the public.

In this way the public has a natural feedback mechanism to constrain those that would seek to track them.”

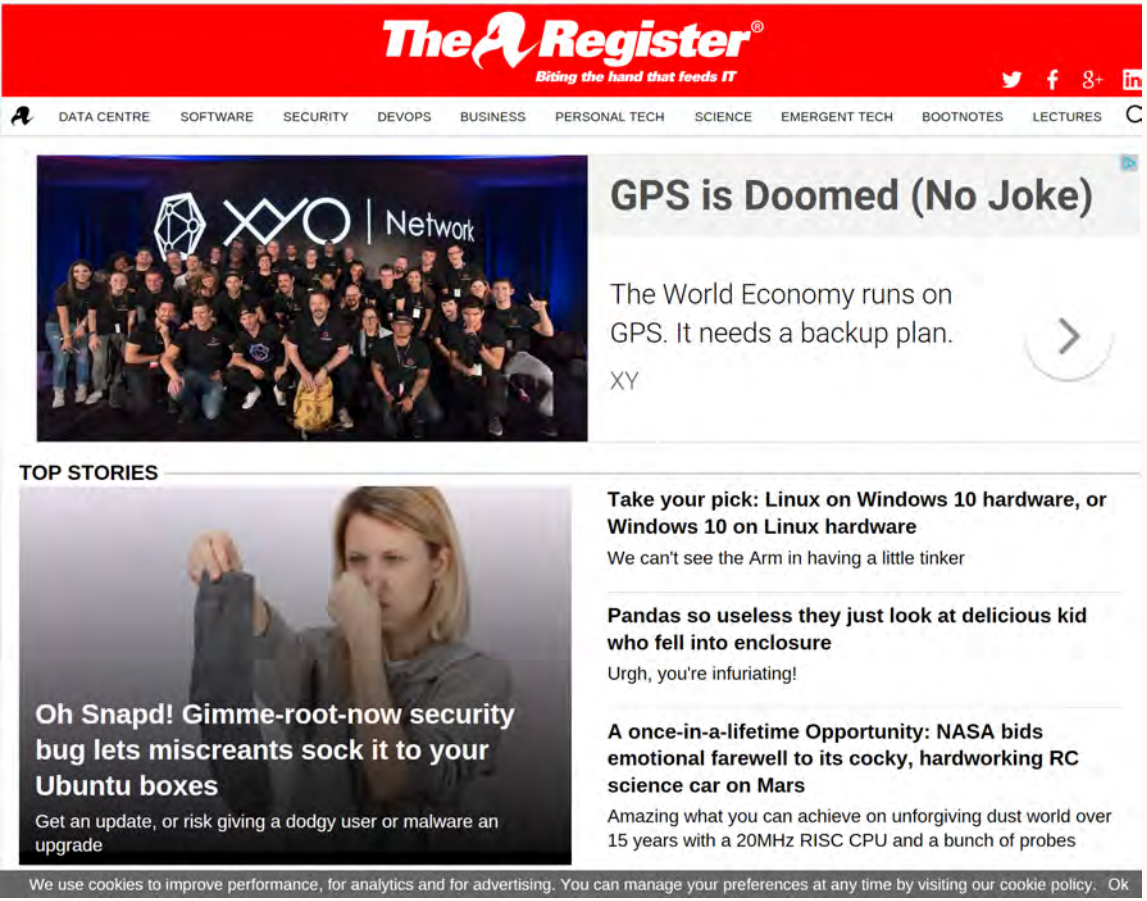
-- Lou Montulli

Websites are made up of many elements from many sources




Sites I went to intentionally
All the ▲ are trackers or content sources contacted by the main site.

Third party cookies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Oh Snapd! Gimme-root-now security bug lets miscreants sock it to your Ubuntu boxes
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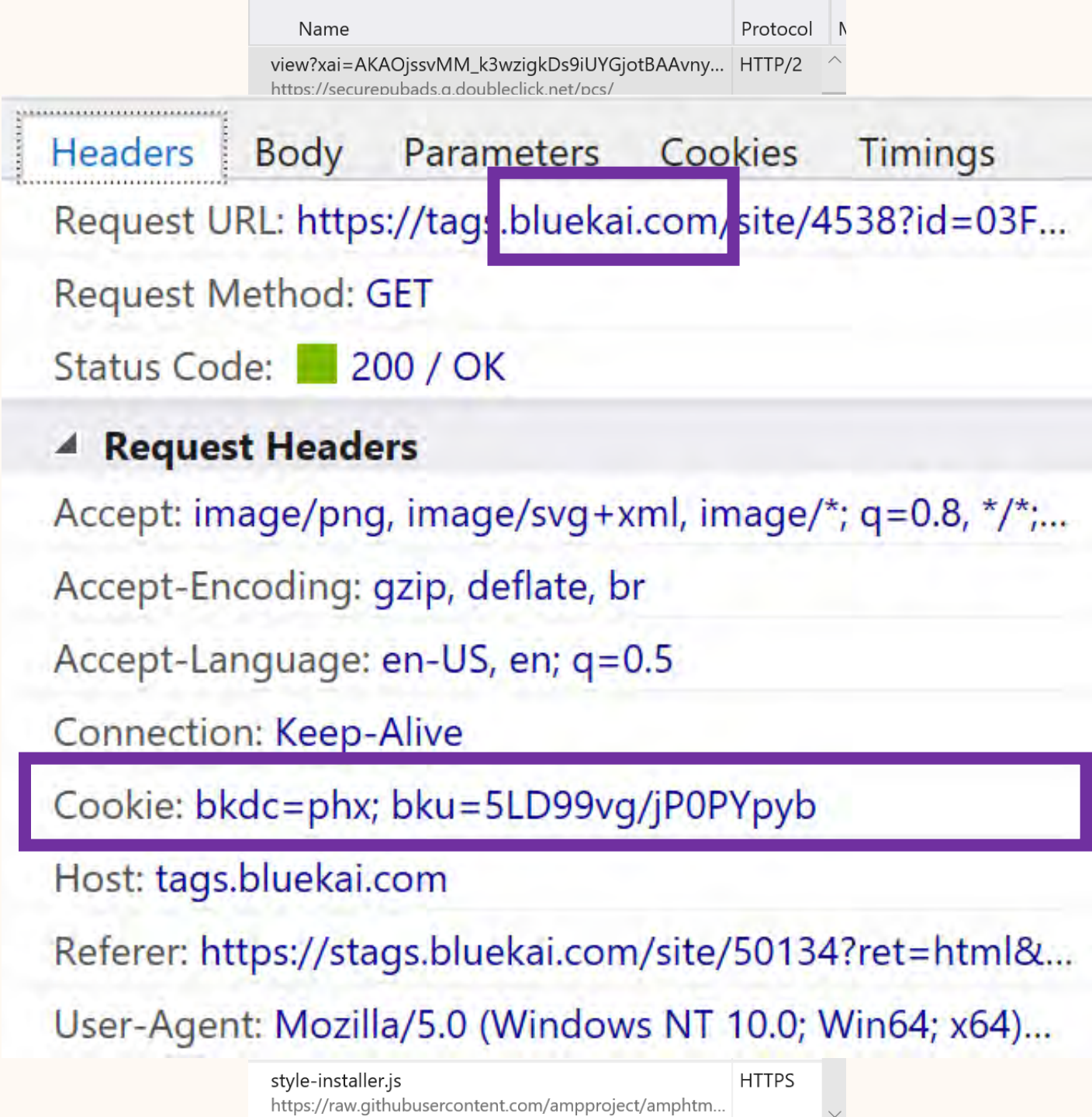
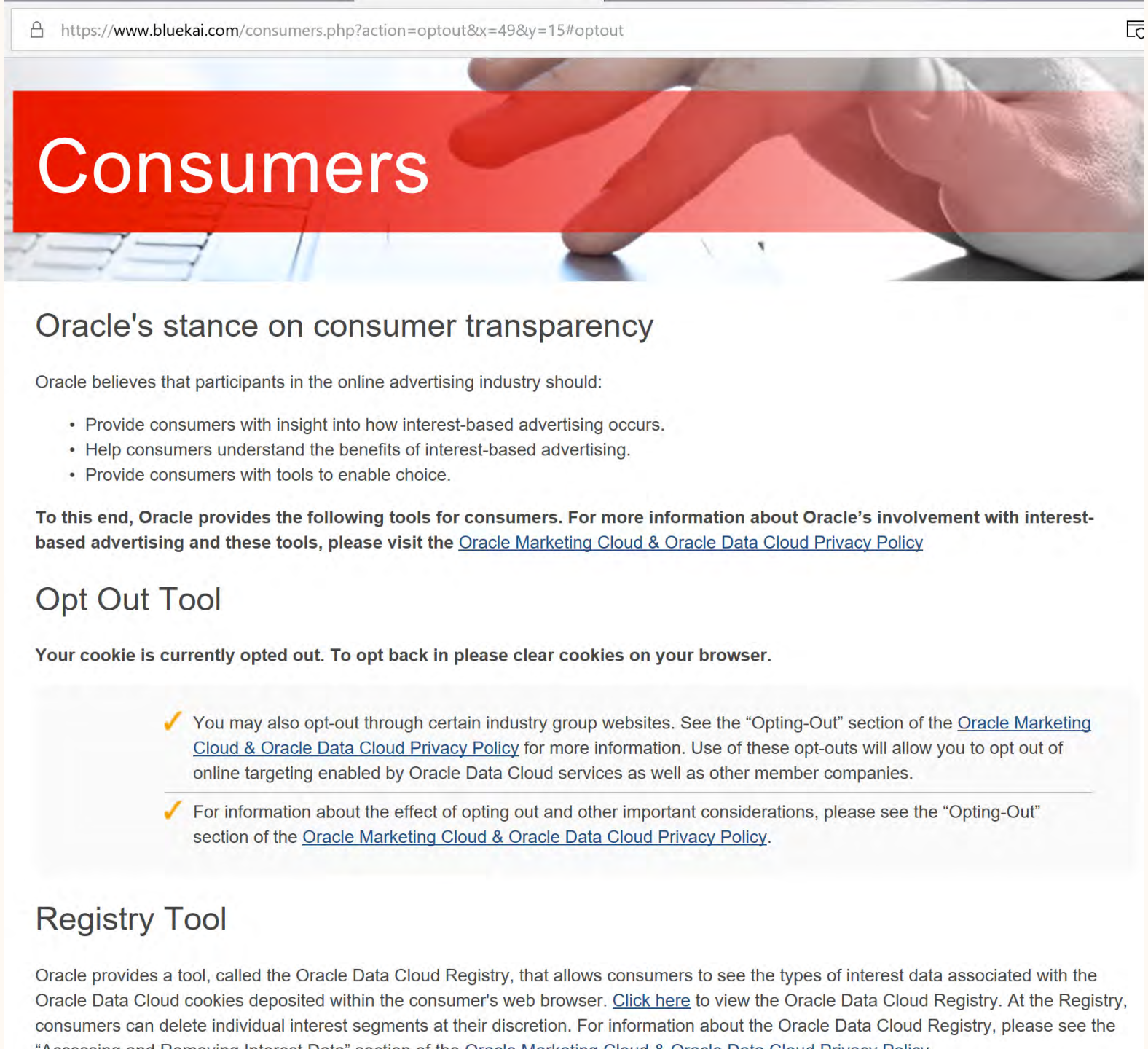
We use cookies to improve performance, for analytics and for advertising. You can manage your preferences at any time by visiting our cookie policy. Ok


Name
Protocol
view?xai=AKAOjssvMM_k3wzigkDs9iUYGjotBAAvny...
HTTP/2
https://securepubads.g.doubleclick.net/pcs/
Headers
Body
Parameters
Cookies
Timings
Request URL: https://tags.bluekai.com/site/4538?id=03F...
Request Method: GET
Status Code: 200 / OK
Request Headers
Accept: image/png, image/svg+xml, image/*; q=0.8, */*;...
Accept-Encoding: gzip, deflate, br
Accept-Language: en-US, en; q=0.5
Connection: Keep-Alive
Cookie: bkdc=phx; bku=5LD99vg/jP0PYpyb
Host: tags.bluekai.com
Referer: https://stags.bluekai.com/site/50134?ret=html&...
User-Agent: Mozilla/5.0 (Windows NT 10.0; Win64; x64)...
style-installer.js
HTTPS
https://raw.githubusercontent.com/ampproject/amphtm...

So I went to BlueKai's opt-out page and asked to opt-out.

Doing so set a cookie so that the next time I visit a site using BlueKai tracker the cookie tells the site not to track me.

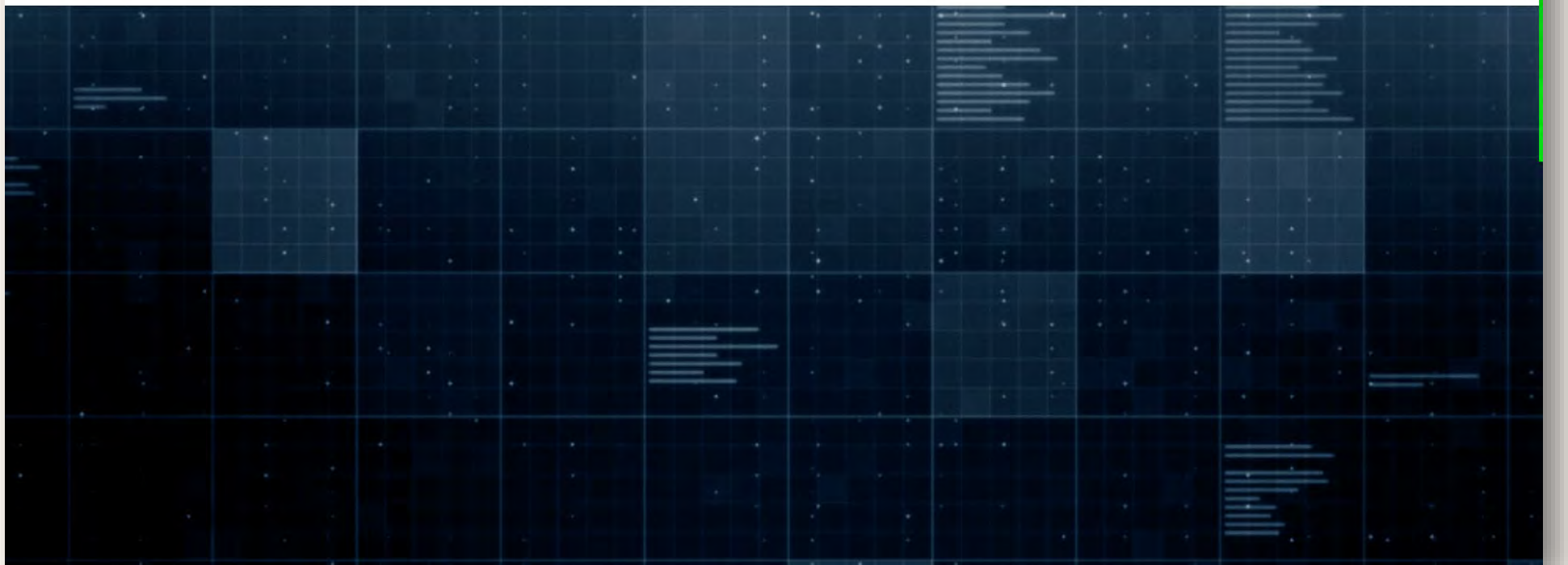


Featured Article

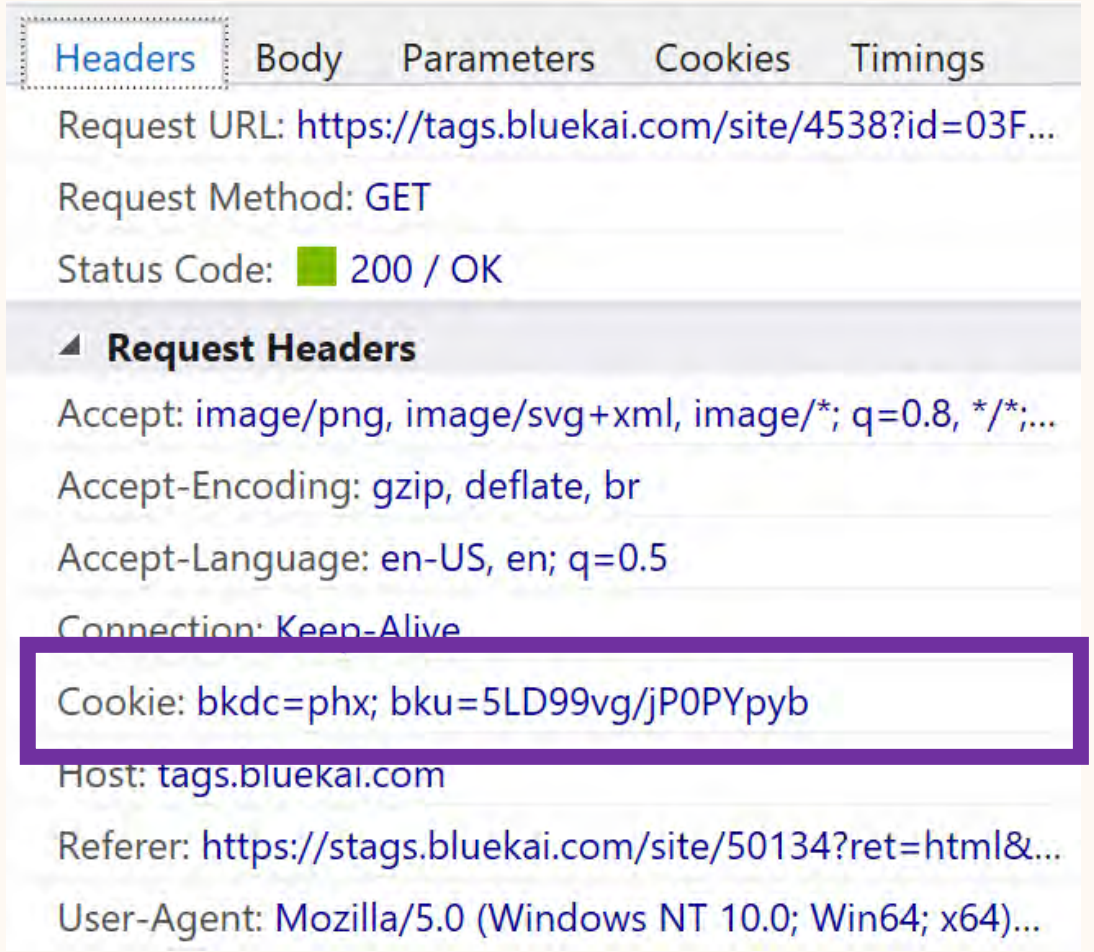
Oracle's BlueKai tracks you across the web. That data spilled online

Billions of records exposed.

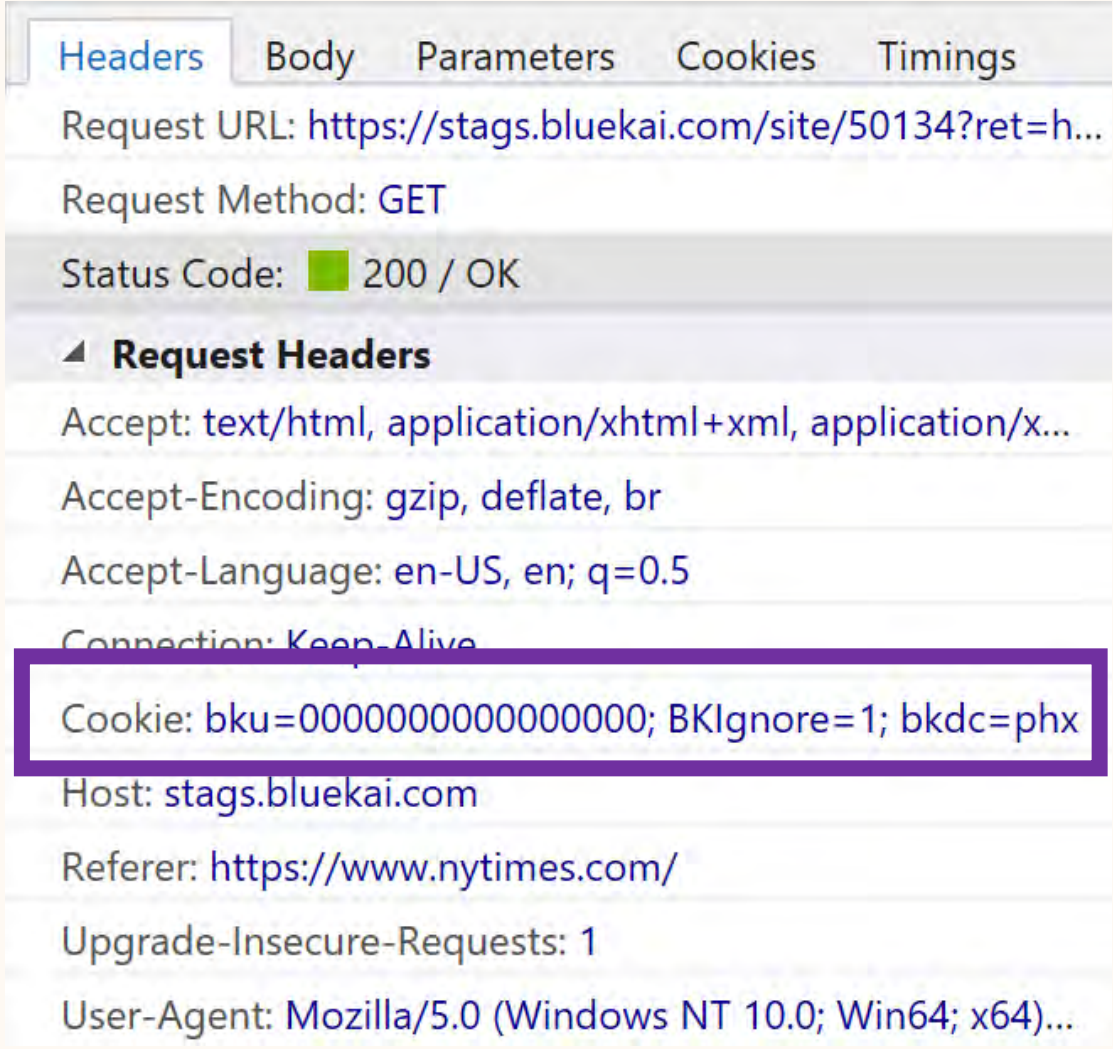
Zack Whittaker @zackwhittaker / 3:30 PM GMT+1 • June 19, 2020



BEFORE OPT-OUT

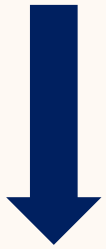


AFTER OPT-OUT



BTW, why “cookie”?

- “Magic cookie”: a token or short packet of data passed between communicating programs



- (Web) cookie

Opting out causes the page to set an “opt out” cookie that is typically blank or all 0’s.

Instead of sending a cookie with a tracking number, your browser will now instead send the blank cookie, preventing the site from tracking you.

Is opt-out a one-stop solution?

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We use cookies to give you the best online experience. Please let us know if you agree to all of these cookies.

Yes, I agree

No, take me to settings

Why we need to conduct a study?

- **Assess needs**: what should we build?
- **Examine trade-offs**: which features/approaches best fit needs?
- **Evaluate**: are requirements met? what can we improve?
- **Finding root causes**: what underlying problems need to be fixed?

Why we need to conduct a study?

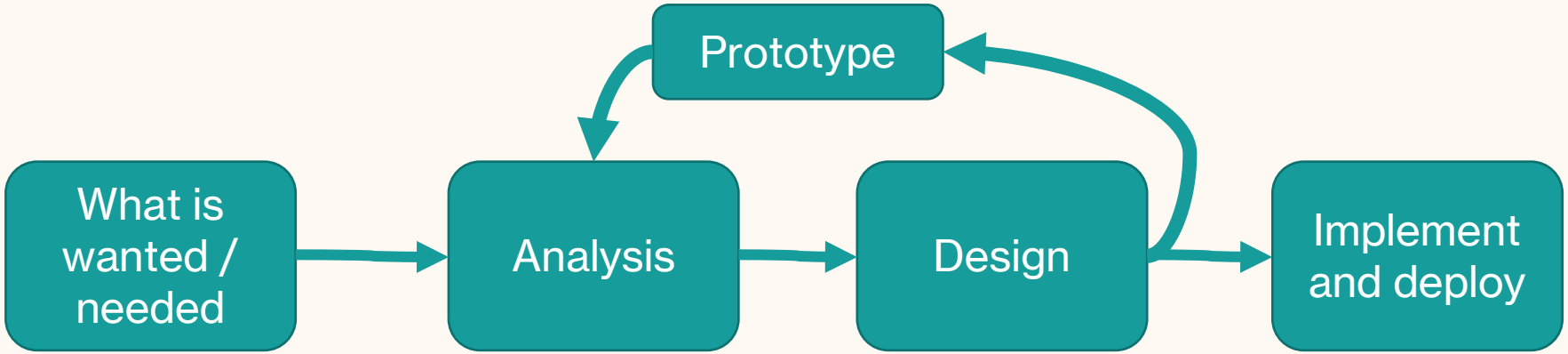
- **Assess needs**: a better cookie notice?
- **Examine trade-offs**: which placement is more accessible?
- **Evaluate**: how fast/accurate people do opt-out?
- **Finding root causes**: dark pattern?

Why we need to conduct a study?

- Assess needs
- Examine trade-offs
- Evaluate
- Finding root causes

CMU USEC

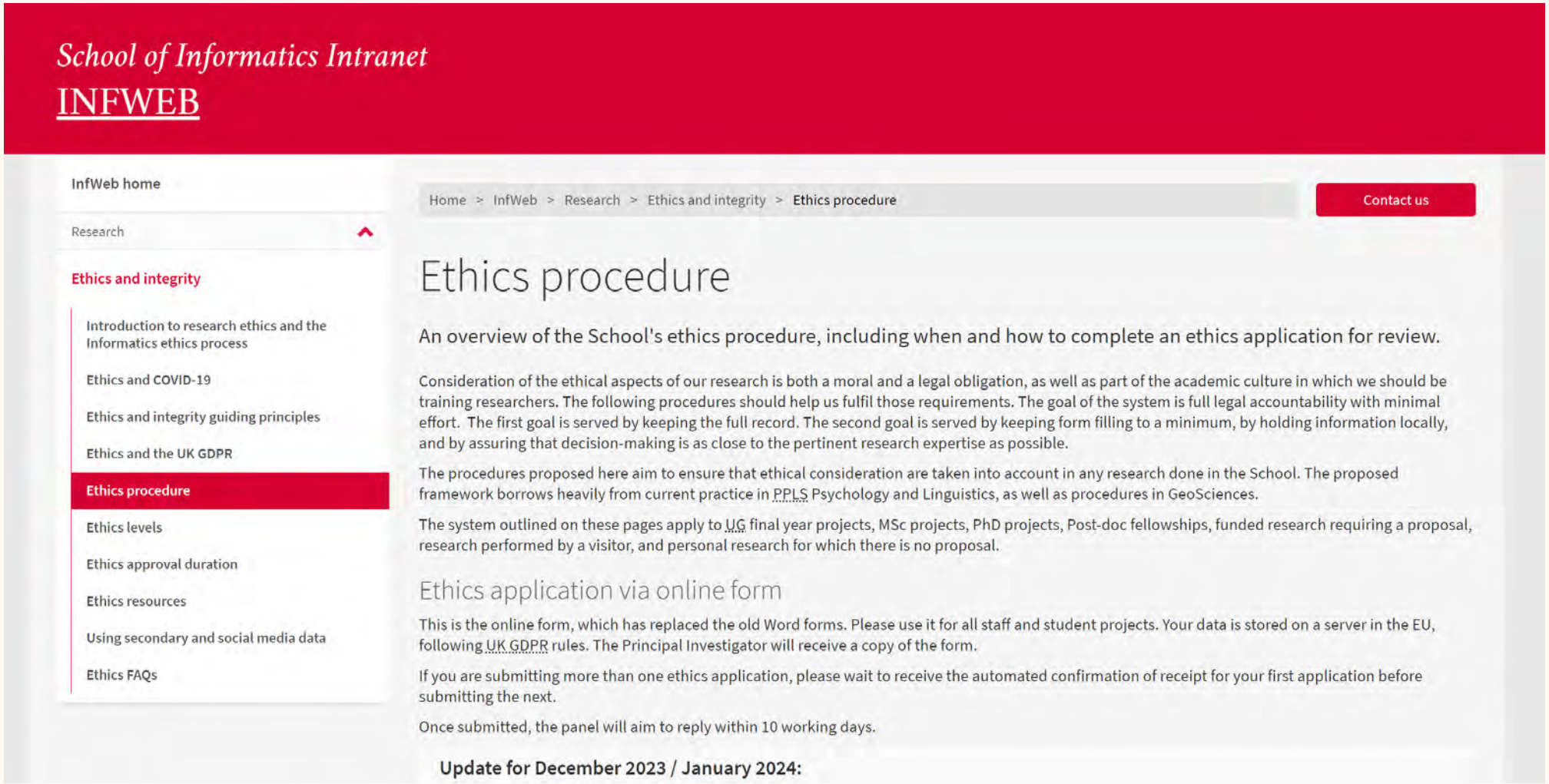
Project lifecycle



Before we actually start

- Identify research questions
- Decide on the type of study and demographics
- Design study protocol
- Obtain ethics approval
- Design study
- Pilot studies
- Revise study....

Ethics guidelines



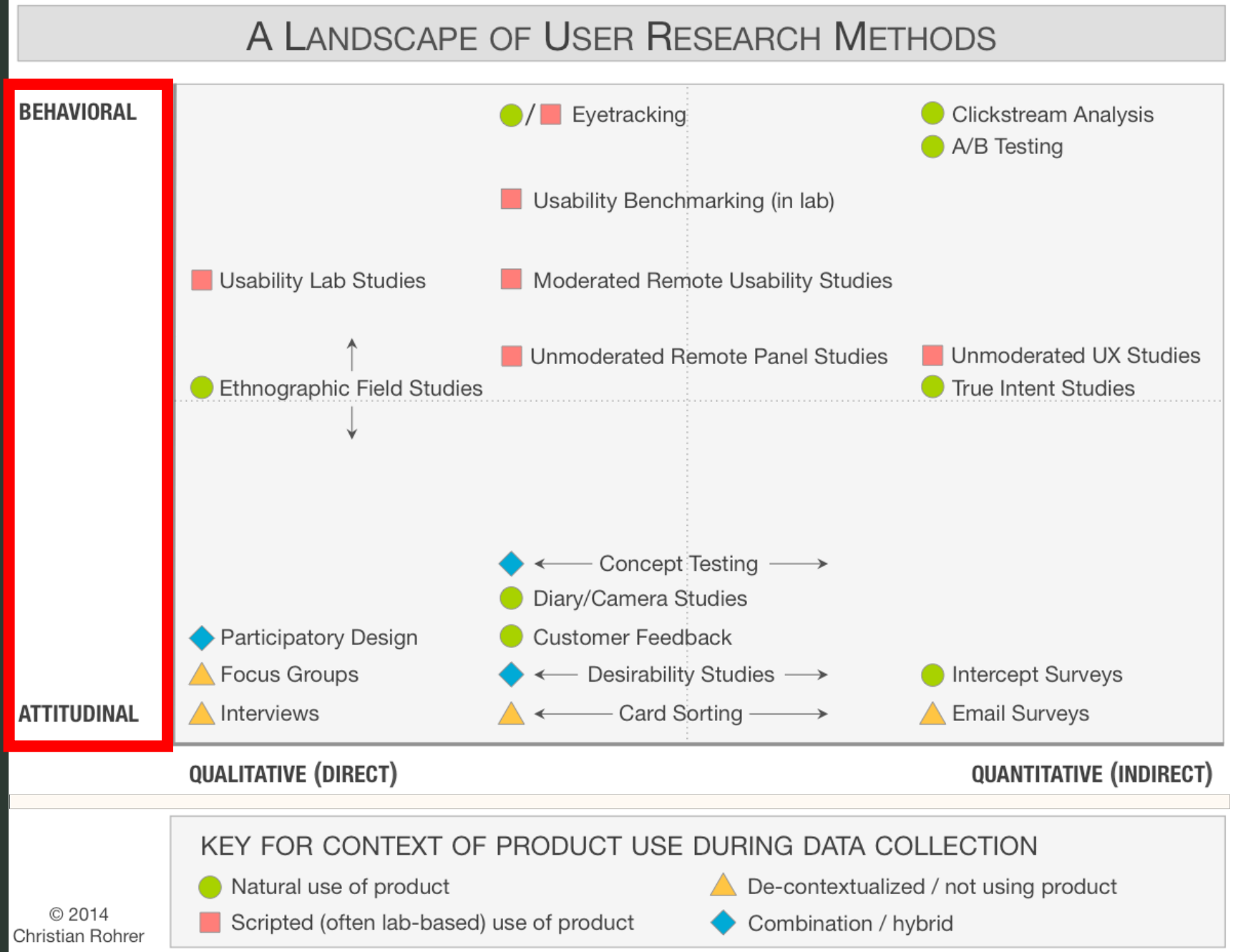
Testing Usability…How?

Many ways to test usability

- A/B Testing
- Affinity Diagraming
- Card Sorting
- Case Studies
- Cognitive Walkthrough
- Competitive Testing
- Critical Incident Technique
- Customer Experience Audit
- Desirability Testing
- Diary Studies
- Ergonomic Analysis
- Experience Sampling
- Experiments
- Eye tracking
- Fly-on-the-wall Observation
- Focus Groups
- Graffiti Walls
- Heuristic Evaluation
- Interviews
- KJ Technique
- Observation
- Participatory Action Research

Behavioral – measures how people actually behave, what they do.

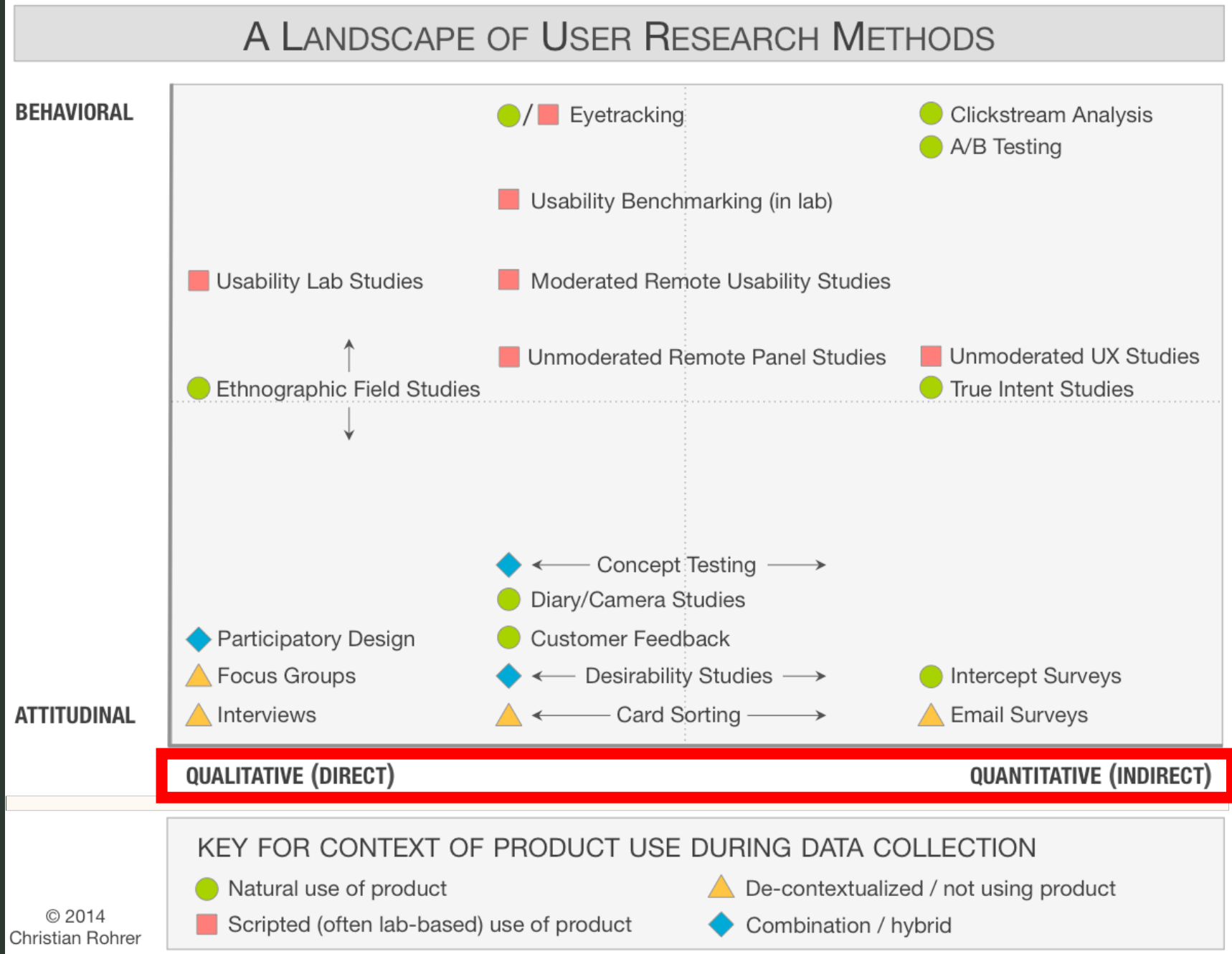
Attitudinal – measures what people say they think or how they say they behave.



https://www.nngroup.com/articles/which-ux-research-methods/

Qualitative – unstructured data such as natural language.

Quantitative – numerical data. Anything that can be counted or measured with numbers.



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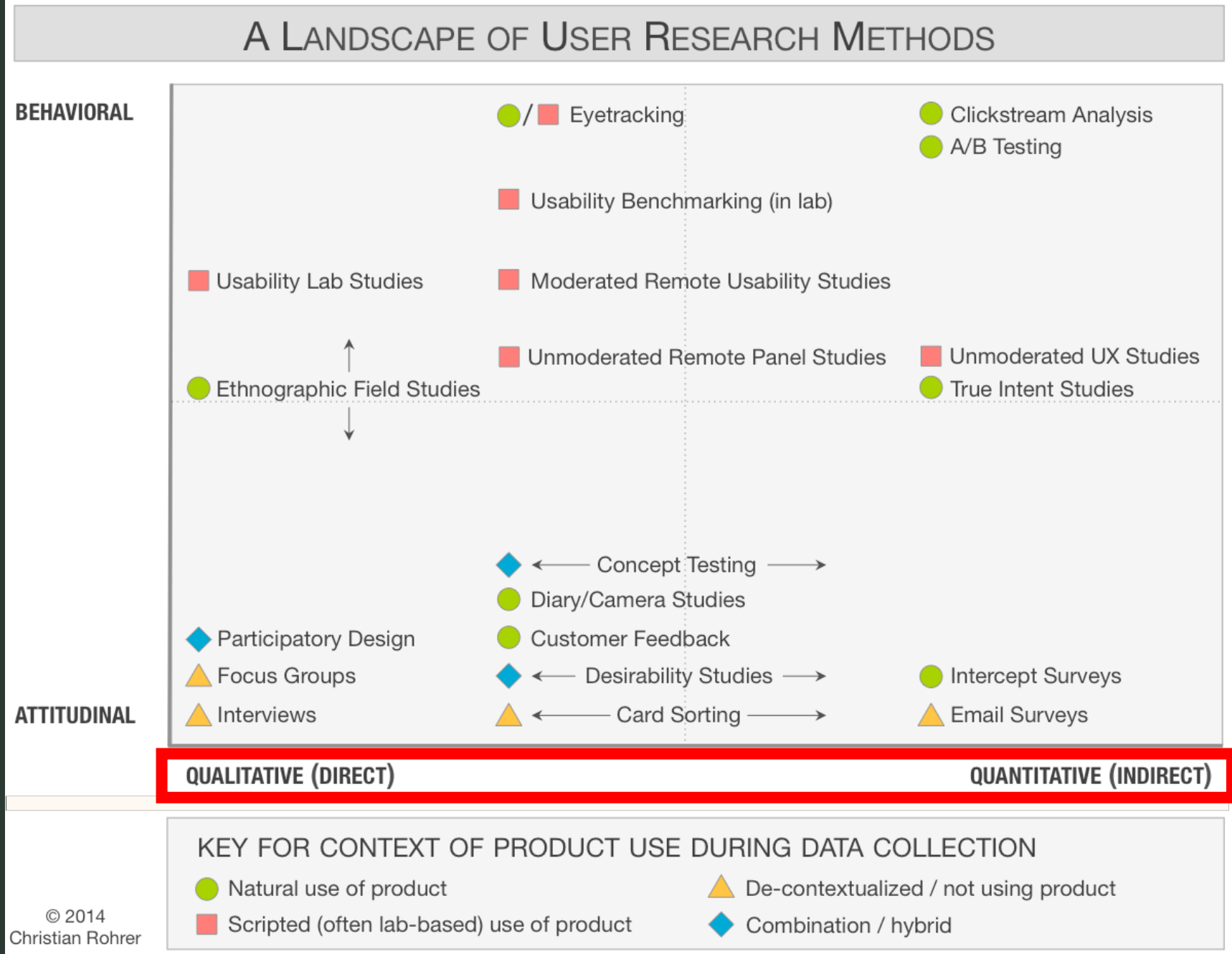
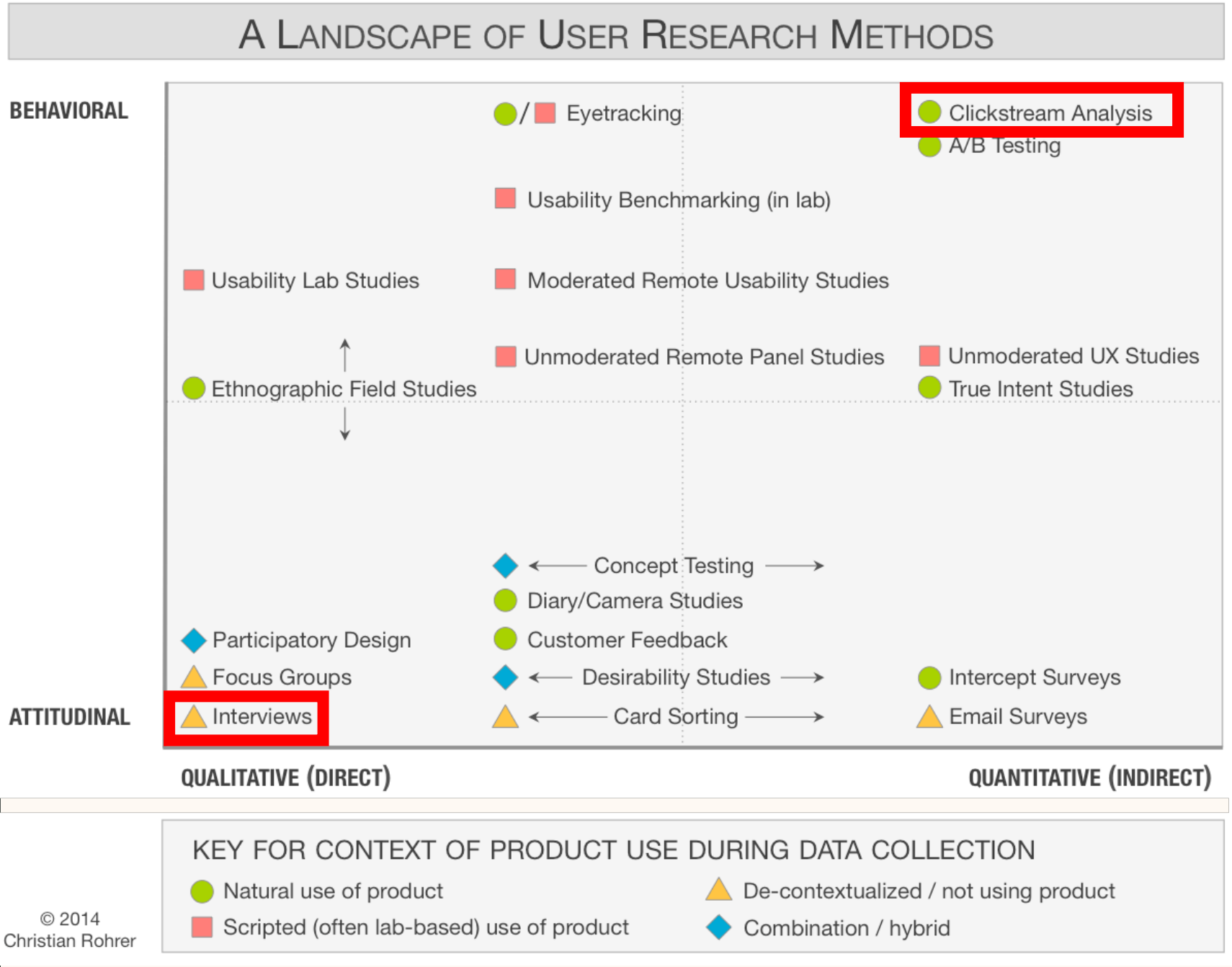


https://www.nngroup.com/articles/which-ux-research-methods/

Interviews – users express their attitudes by providing qualitative answers to questions.

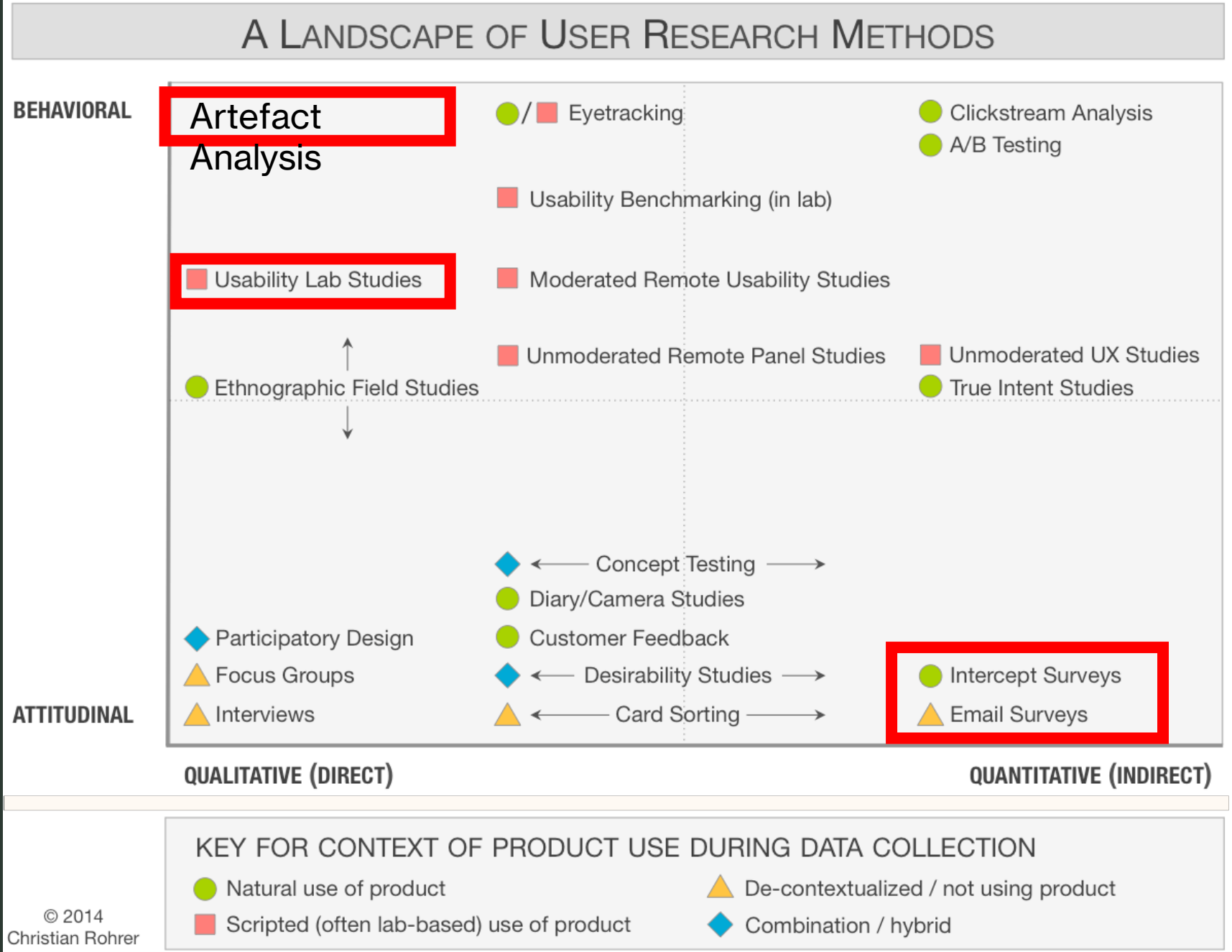
Clickstream Analysis – measure the links users click on to get quantitative data on what users do.



https://www.nngroup.com/articles/which-ux-research-methods/

Lab Studies – users perform a set of tasks often talking about their experience as they do so.

Surveys – Ask about user opinion often with multiple choice answers.



https://www.nngroup.com/articles/which-ux-research-methods/

Think-pair-share

For each of the following problems, name one behavioral question you could ask and one attitudinal question.

- Mobile phone login
- Cookie dialogs
- Fake news
- Encryption of all webpages by default

Lab studies are a simple idea. You ask a user to come into a physical space and ask them to interact with the interface there.

Lab Study

- Basic idea: Have a participant come to a physical place (lab) and interact with the interface there
- You setup the lab so it mimics the situation you want to test
- Pros
  - Full control over the environment so limited confounds
  - Detailed data from each subject
  - Ability to ask them why they did something
- Cons
  - Small sample sizes
  - Being in the lab changes user behavior. They feel safer and their normal distractions are gone. That can be bad for deception studies.

Is it really simple?

What is different about security

- Large **information asymmetry** between participant and researcher
  - The researcher likely understand security of their tool
  - Participant likely doesn’t even know that security problem exists
- **Deception** studies are common
  - You told the participant to accomplish task A, but you are really looking to see if they do B activity

Why Johnny Can’t Encrypt

In Proceedings of the 8th USENIX Security Symposium, August 1999, pp. 169-183

Why Johnny Can’t Encrypt: A Usability Evaluation of PGP 5.0

Alma Whitten
School of Computer Science
Carnegie Mellon University
Pittsburgh, PA 15213
alma@cs.cmu.edu

J. D. Tygar[1]
EECS and SIMS
University of California
Berkeley, CA 94720
tygar@cs.berkeley.edu

Abstract

User errors cause or contribute to most computer security failures, yet user interfaces for security still tend to be clumsy, confusing, or near-nonexistent. Is this simply due to a failure to apply standard user interface design techniques to security? We argue that, on the contrary, effective security requires a different usability standard, and that it will not be achieved through the user interface design techniques appropriate to other types of consumer software.

To test this hypothesis, we performed a case study of a security program which does have a good user interface by general standards: PGP 5.0. Our case study used a cognitive walkthrough analysis together with a laboratory user test to evaluate whether PGP 5.0 can be successfully used by cryptography novices to achieve effective electronic mail security. The analysis found a number of user interface design flaws that may

1 Introduction

Security mechanisms are only effective when used correctly. Strong cryptography, provably correct protocols, and bug-free code will not provide security if the people who use the software forget to click on the encrypt button when they need privacy, give up on a communication protocol because they are too confused about which cryptographic keys they need to use, or accidentally configure their access control mechanisms to make their private data world-readable. Problems such as these are already quite serious: at least one researcher [2] has claimed that configuration errors are the probable cause of more than 90% of all computer security failures. Since average citizens are now increasingly encouraged to make use of networked computers for private transactions, the need to make security manageable for even untrained users has become critical [4, 9].

Why Enc

In Proceedings of the 8th USENIX Security Symposium, August 1999, pp. 169-183

If an average user of email feels the need for privacy and authentication, and acquires PGP with that purpose in mind, will PGP's current design allow that person to realize what needs to be done, figure out how to do it, and avoid dangerous errors, without becoming so frustrated that he or she decides to give up on using PGP after all?

interface by general standards: PGP 5.0. Our case study used a cognitive walkthrough analysis together with a laboratory user test to evaluate whether PGP 5.0 can be successfully used by cryptography novices to achieve effective electronic mail security. The analysis found a number of user interface design flaws that may

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Users need to:

- understand that privacy is achieved by encryption, and figure out how to encrypt email and how to decrypt email received from other people
- understand that authentication is achieved through digital signatures, and figure out how to sign email and how to verify signatures on email from other people
- understand that in order to sign email and allow other people to send them encrypted email a key pair must be generated, and figure out how to do so
- understand that in order to allow other people to verify their signature and to send them encrypted email, they must publish their public key, and figure out some way to do so
- understand that in order to verify signatures on email from other people and send encrypted email to other people, they must acquire those people's public keys
- manage to avoid such dangerous errors as accidentally failing to encrypt, trusting the wrong public keys, failing to back up their private keys, and forgetting their pass phrases
- be able to succeed at all of the above within a few hours of reasonably motivated effort

Tested usability using two methods

- Cognitive Walkthrough
  - A set of experts review the experts and make an informed guess about what will be problematic
  - Paired with heuristics – The experts state how the user interface supports or violates common HCI principles (Heuristics)
- Lab Study
  - Ask the participant to perform a set of tasks
  - Very similar to a think aloud, but without the talking aloud part

Cognitive walkthrough outcomes

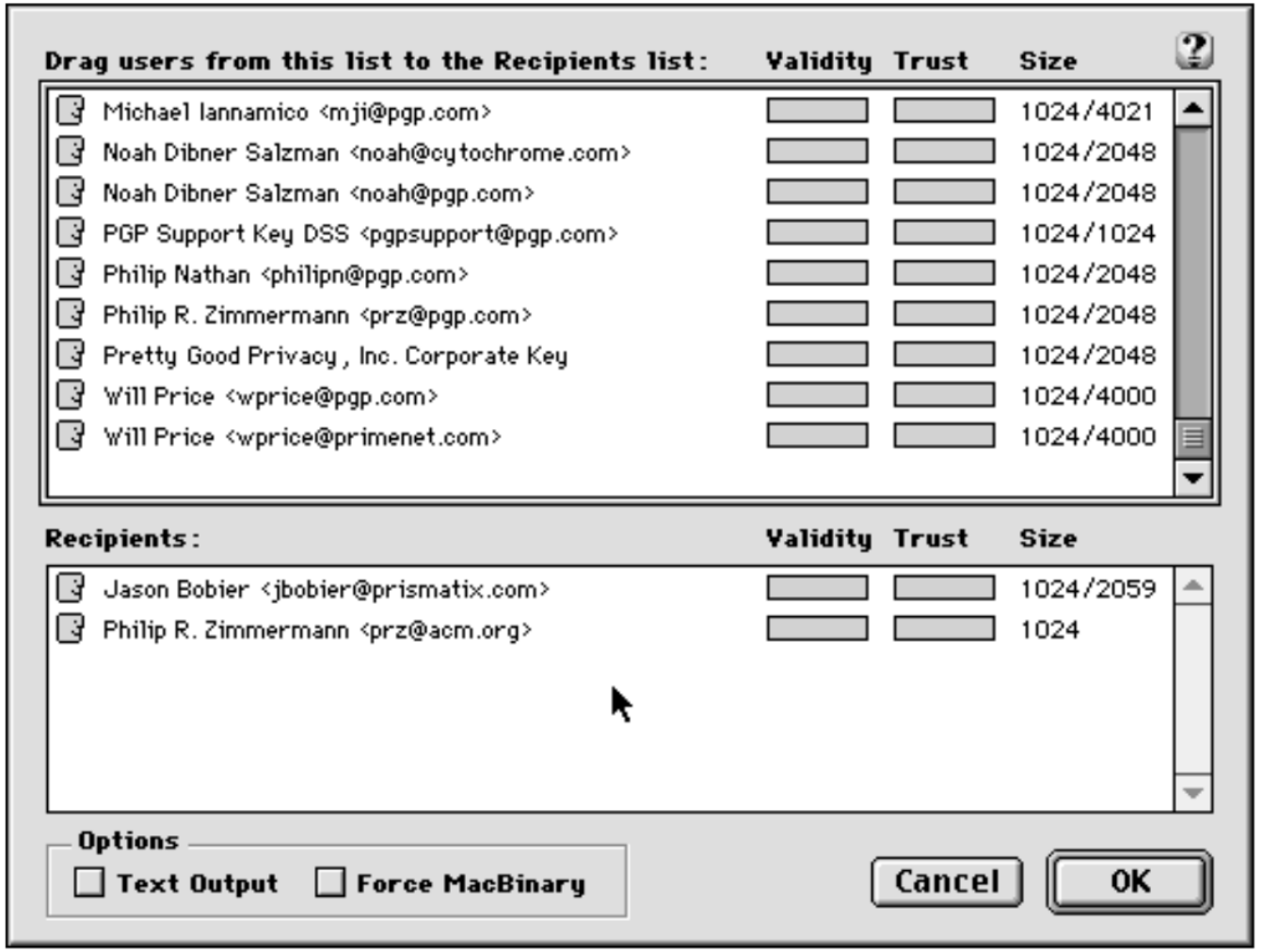
- **Visual metaphors** – Do key and lock pictures make sense?
- **Different key types** – Public vs private keys, or maybe signing and encryption keys?
- **Key server** – Used for sharing keys
- **Key management policy** – Trust and validity ratings
- **Consistency** – Use of the same terms everywhere
- **Too much information** – Information like key size, hashes, and trust
- **Irreversible actions**
  - Accidentally deleting the private key
  - Accidentally publicizing a key
  - Accidentally revoking a key
  - Forgetting the pass phrase
  - Failing to back up the key rings

Lab study

- 12 participants with CS backgrounds
- Participant had to send several emails to team members (the researchers)
  - Creating a key pair
  - Sending their public key to team members
  - Getting team members' public keys
  - Sending the email
  - Decrypting response email

- 3 – emailed the private key to the team member
  - 1 never realized the error
- 1 – forgot their pass phase and had to re-generate keys
- 1 – never figured out how to encrypt
- 7 – used their public keys to encrypt
  - 1 created a separate key pair for each team member
- 3 – successfully sent an encrypted email to the whole team and were able to decrypt an response email

Whitten and Tygar evaluated PGP encryption in 1999, surely it must be more usable now.



A personal story during my PhD

Kalɛido: Real-Time Privacy Control for Eye-Tracking Systems

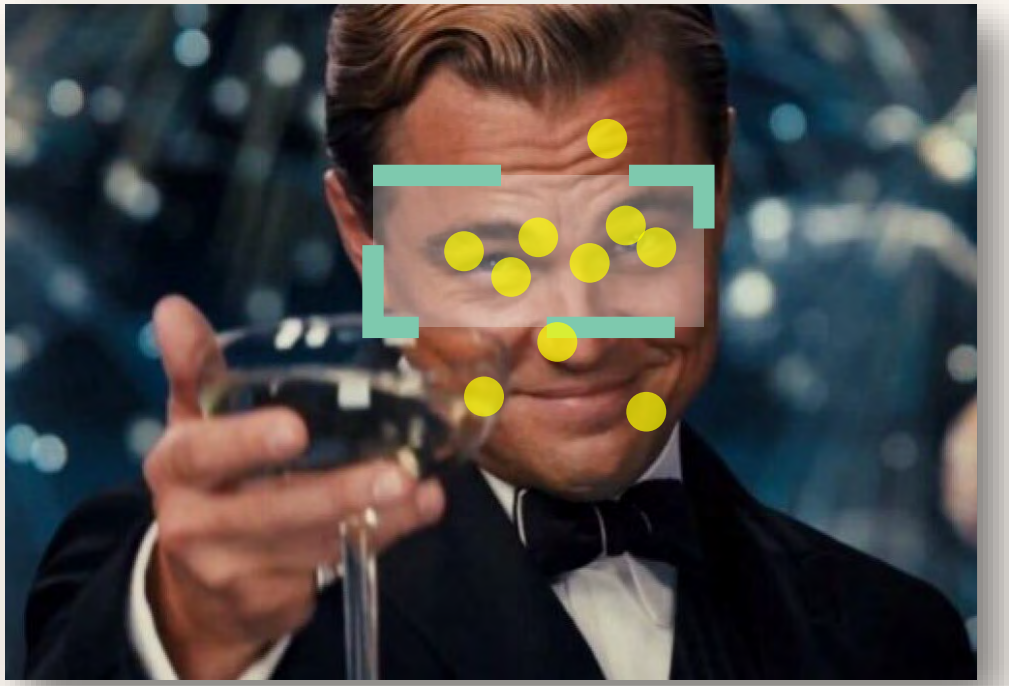
Jingjie Li, Amrita Roy Chowdhury, Kassem Fawaz, and Younghyun Kim
University of Wisconsin–Madison
{jingjie.li, roychowdhur2, kfawaz, younghyun.kim}@wisc.edu

Abstract

Recent advances in sensing and computing technologies have led to the rise of eye-tracking platforms. Ranging from mobiles to high-end mixed reality headsets, a wide spectrum of interactive systems now employs eye-tracking. However, eye gaze data is a rich source of sensitive information that can reveal an individual's physiological and psychological traits. Prior approaches to protecting eye-tracking data suffer from two major drawbacks: they are either incompatible

Figure 1: Eye gaze heatmaps from an individual user with and without Kalɛido's noising effect on a web page.

Privacy Implications of Eye Tracking



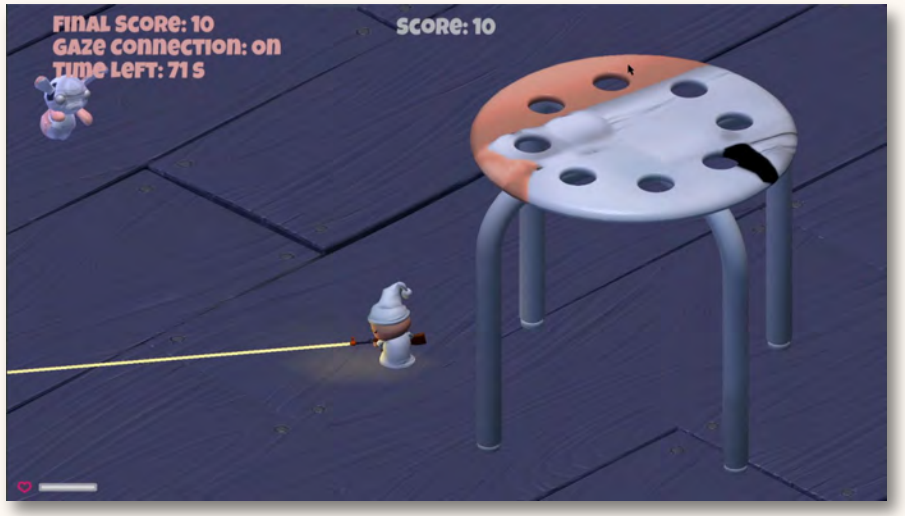
Eye gazes from people
with **low social anxiety**

Eye gazes from people
with **high social anxiety**

Some background

- Test out whether/how user experience is impacted by a privacy control we designed in an eye tracking game setting

Kalɛido off

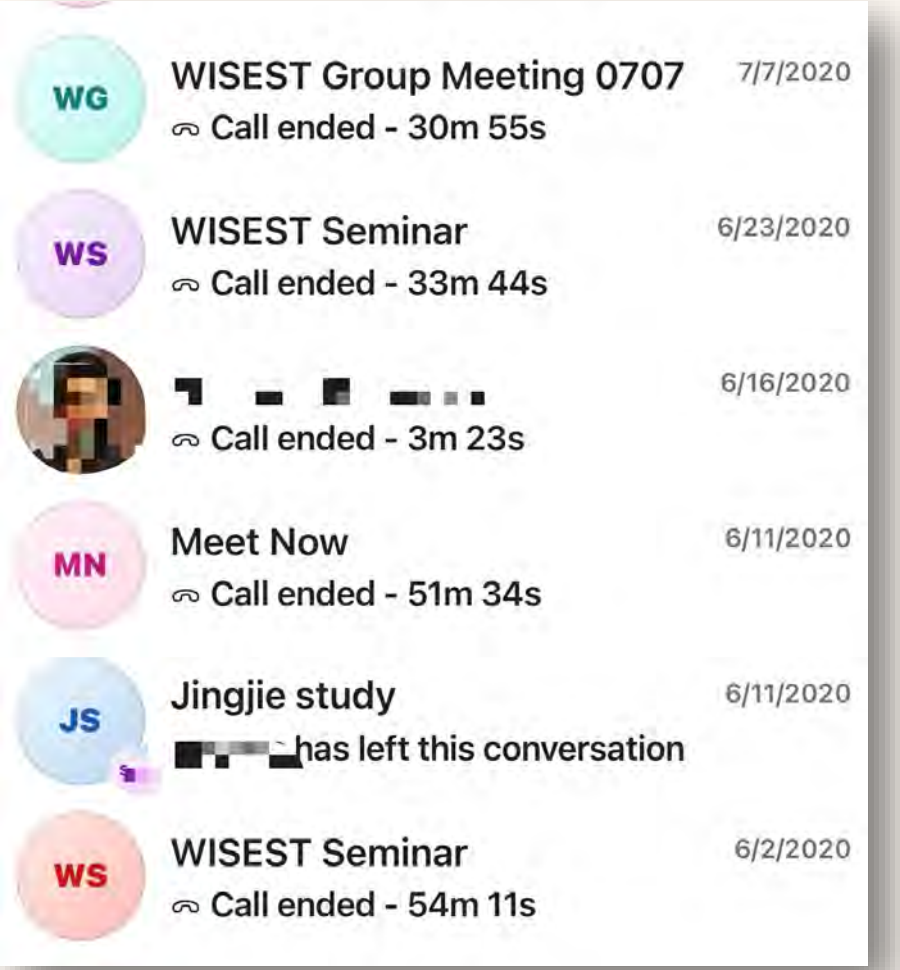


Kalɛido on

How to do user studies?

My original plan in **03/2020** to do lab studies with a VR setup

Then...Guess what?



“The remote user study design was approved by the Institutional Review Board (IRB) of our institution... Each remote session took 35 minutes on average, and we provided each participant with $15 worth of supplies as a token of appreciation for participating.”

Questions

Take-home

- **(Blog)** Chandrasekaran, V., Banerjee, S., Mutlu, B. and Fawaz, K., 2021. {PowerCut} and Obfuscator: An Exploration of the Design Space for {Privacy-Preserving} Interventions for Smart Speakers. In Seventeenth Symposium on Usable Privacy and Security (SOUPS 2021) (pp. 535-552).
- **(Blog)** BBC - Google Chrome starts blocking data tracking cookies